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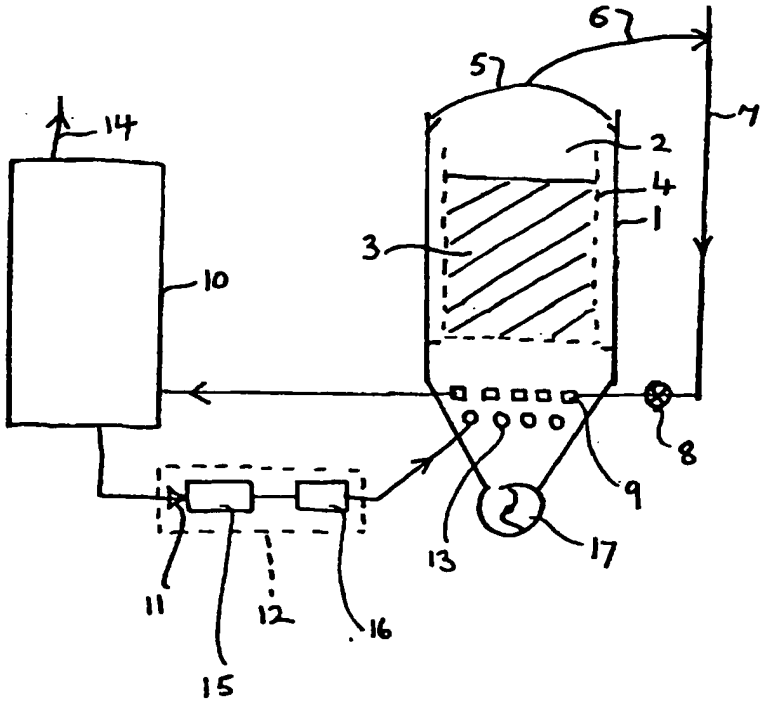
(54) Abstract Title
Treating bio-degradable waste material

(57) Apparatus for the treatment of bio-degradable waste material (3) comprises housing (1) defining chamber (2) for receiving the material and means (10, 11, 13) for agitating material (3) in chamber (2) by supplying gas generated from bio-degradation of the material into a lower part of the chamber. Gas is withdrawn from chamber (2) and pump (8) compresses the gas, the rise in temperature produced by the compression being used to heat material in the lower part of the chamber by passing the compressed gas through piping (9) in the lower part of chamber (2), agitating means (10, 11, 13) recirculating the gas back to the lower part of the chamber. The agitating means comprises storage tank (10) for storing gas generated from th bio-degradation of the material and means for supplying gas (11, 13) from tank (10) to the lower part of the chamber, piping (9) being connected to storage tank (10).

There may also be a lower set of agitation pipes.



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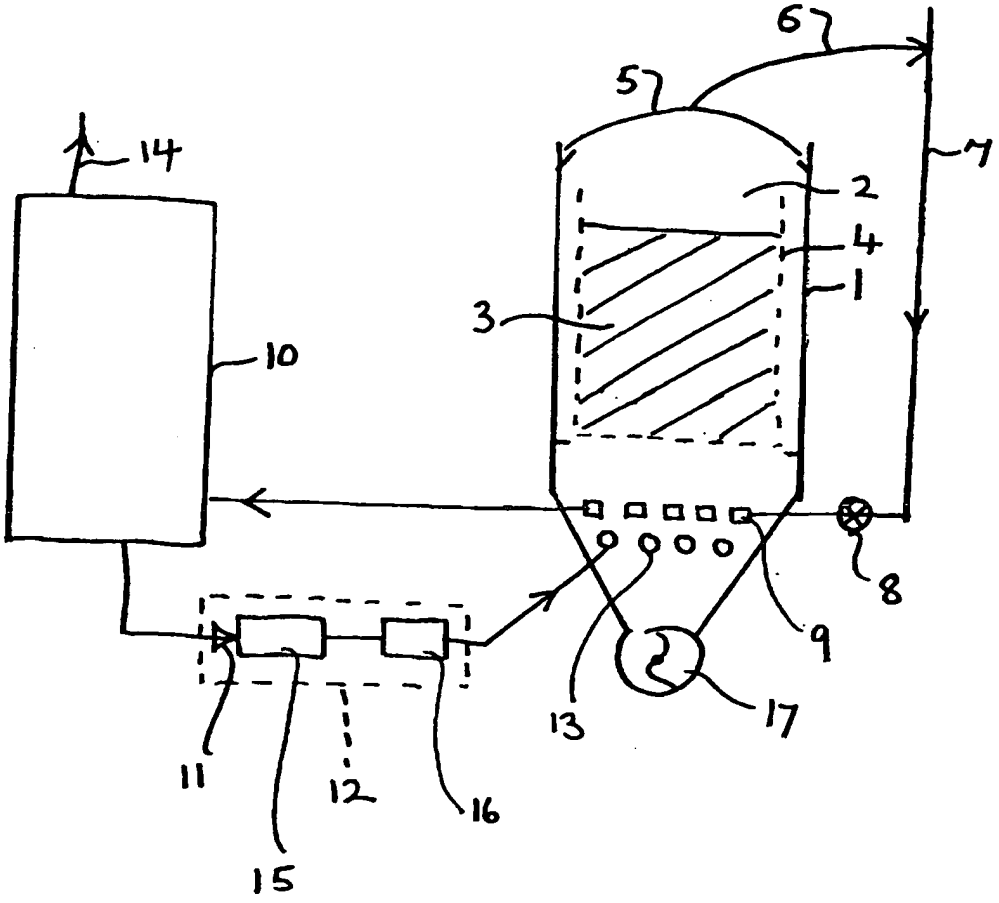
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APPARATUS AND METHOD FOR WASTE TREATMENT

The present invention relates to an apparatus and a method for waste treatment.

There are a number of processes for digesting sewage or other fluids containing bio-degradable material. Commonly in the UK the process is mesophilic digestion. In this case, fluids containing organic matter (including sewage, farm animal slurries or other such organic "wastes") are held within a sealed container and circulated. Heat may be added as necessary to bring the temperature to about 25 to about 38°C. The process is one of bacterial action which results in some degradation of the organic matter which kills some of the organisms present, releases some methane gas and significantly reduces odour. In some other countries, notably the USA, a thermophilic process is also used, which operates at about 60°C. More gas is produced and there is a full pasteurising effect.

Municipal Solid Waste (MSW) is produced in large volumes by all human populations and disposal of it is a major cost, also involving a number of potentially serious environmental costs. Efforts to separate MSW into its basic constituents, so as to be able to re-cycle the substances involved, have usually been based on mechanical methods which have generally proved to be expensive, technically inadequate or both. Thermophilic digestion has been used involving one tank of sewage and one of MSW, with the sewage pumped through the MSW so as to separate the bio-degradable material by dissolving it. Heat is added to the system by electrical heating of the fluid of the system (the sewage or other bio-degradable liquid). Twin tank systems cost more money and lose more heat from the process. Heating the fluid may involve either "furring up" of the heating elements due to sedimentation or separate

heaters. Agitation of the system is either mechanical or by the pumped fluids which is power consuming and slow.

According to the present invention from one aspect, there is provided apparatus for the treatment of bio-degradable waste material, comprising means defining a chamber for receiving such material and means for agitating the material in the chamber by supplying gas generated from bio-degradation of said waste material into a lower part of the chamber.

The apparatus preferably is adapted for the thermophilic treatment of said material.

The apparatus may comprise means for withdrawing gas from the chamber and pumping means for compressing such gas, the rise in temperature produced by the compression being used to heat material in the lower part of the chamber by passing the compressed gas through piping in the lower part of the chamber, the agitating means re-circulating such gas back to the lower part of the chamber.

There may be further piping below the first-mentioned piping and which receives gas to be supplied to the lower part of the chamber, such gas bubbling out of said further piping and through the waste material.

The agitating means may comprise means for storing gas generated from the bio-degradation of the material and means for supplying gas from the storing means to the lower part of the chamber.

The apparatus may include means for heating gas supplied to the lower part of the chamber.

According to the present invention from another aspect, there is provided a method for the treatment of bio-degradable waste material, comprising receiving such material in a chamber and agitating the material in the chamber by supplying gas generated from bio-degradation of said waste material into a lower part of the chamber.

The present invention will now be described, by way of example, with reference to the single Figure of the accompanying drawing which is a schematic view of one example of apparatus according to the present invention.

Referring to the drawing, reference numeral 1 designates a digester housing defining a chamber 2 which receives MSW or other solid waste 3 which may be held in a carrying cage 4 of steel or other suitable material. The housing 1 has a removable and sealable lid 5 from which a flexible connection 6 leads to a pipe 7, a pump 8 close to the lower part of the housing 1 acting to compress gas from pipe 7 which passes through pipes 9 in the lower part of the housing 1 and thence to a gas storage tank 10.

Gas from the tank 10 is re-circulated into the lower part of the digester housing 1 via an expansion valve 11, an arrangement 12 for heating re-circulated gas and gas bubble generating pipes 13 below the pipes 9, the gas passing up between the pipes 9 and through the chamber 2. Excess gas from tank 10 passes out of an outlet 14 for other use.

The operation of the apparatus is as follows.

The MSW or other solid waste 3 is introduced into the chamber 2, there being a means of introducing the MSW or other solid waste, including its carrying cage 4 if one is employed, after which the chamber is sealed and the gas trapped in the system is circulated to agitate the MSW or

other solid waste. This is carried out by bubbling the gas up from the pipes 13 through the solid material. Heat is supplied, as a result of heat of compression, from the compressed gas passed through pipes 13, which pipes pass through the liquid in the chamber 2, the heat of compression being transferred to the liquid in the manner of a heat pump. The gas passes out of the chamber 1 and into the tank 10 from which surplus gas may be taken. Gas is allowed to exit from the tank 10 through expansion valve 11, so allowing cooling to take place. Heating arrangement 12 may be used to heat the gas, which gas which is allowed to enter the lower part of the chamber 2 of the apparatus, so bubbling up through the liquid and solid material to be separated and digesting out the bio-degradable material by a mixture of physical and biological activity. In the heating arrangement 12, reference numeral 15 designates a heating coil which picks up heat from the outside and reference numeral 16 designates an optional heater.

The gas pressure delivered by the pump 8 in order to deliver to the holding tank 10 will normally be higher than that required to pass through the liquid in the chamber 2. How much higher will depend on the economics of gas compression, the cost of the tank 10, the advantage to be gained from using heat of compression and the scope to pick up heat from the outside environment using heating coil 15.

If heat is required to be added to raise the temperature of the liquid in the chamber 2 (as will normally be required at the start of the process) then it is added either in the heating coil 15 in the heating arrangement 12 or between that device and the release of gas into the lower part of the chamber 2 using a heater 16 (via electrical heating using heater wires in the gas flow or by heating the gas by indirect means such as solar heating panels, burning gas

from the system itself, or other fuel, so as to heat the gas in the system).

The MSW or other solid waste to be treated may be delivered in skips or lorries which can tip their load. In order to load the apparatus, the material may be passed along a conveyor which contains a bag and container tearing/puncturing device in order that the bio-degradable material will be exposed in the apparatus.

A particular method of containing the solid waste while allowing bubbles of gas to pass through it from pipes 13 during the process, and yet still allowing easy removal of residue at the end of the process, is to hold the solid waste in such a cage 4 which can be lifted clear, drained and then emptied allowing removal of the contents for other treatment or disposal. However, under some circumstances, other arrangements may be made - for example the floor of the digester housing 1 may be made with a grid, or pipes with gas orifices may be inserted into the mass of solid waste.

In the UK, MSW commonly has a bio-degradable content in the region of 23%. Agricultural solid wastes, trade wastes and other industrial wastes which may be treated may have different proportions and conditions will vary under different circumstances and in different countries or different times. Such wastes may have other residues which are not bio-degradable but are not bio-unfriendly, e.g. inert dust, hair, small particles of synthetic materials etc. In MSW in the UK, such materials may be up to 44% of the total, making in the region of 67% of the total which could be described as "not bio-unfriendly" and which could be separated by apparatus according to the present invention and re-cycled to the surface of land for incorporation into the surface as part of the soil. These

materials often clog up treatment systems and may or may not be desirable in the recycling of following processes. The digester housing 1 may be designed so as to allow such materials to sediment out to the bottom of the housing, which will allow either incorporation into the liquid to be drained at the end of the process or separation out by sedimentation or screening after the process. Some farm land may benefit from addition of such a material and it is likely to be either useful or acceptable as a disposal route to land reclamation, bank stabilisation, forestry, landscaping or other such application. The present invention then provides an alternative disposal route for material which might otherwise be used as landfilling.

In the above embodiment, there are two sets of pipes, the upper set being the pipes 9 which are hot and connected to the pump 8. These pipes transfer the heat of compression to liquid in the chamber 2. The lower set of pipes 13 carry the lower pressure gas back from the tank 10 into the lower part of chamber 2 where it escapes from orifices in the pipes to produce agitation bubbles. Below pipes 13 there might not be enough space to allow sedimentation of small particles, which will only be allowed at the end of the process for a few hours before emptying the apparatus. Alternatively, there may be two sets of agitation pipes 13 so that the lower set may be shut down in the latter part of the process to allow sedimentation if carrying the sediment in suspension were seen to be limiting further breakdown of material as desired. This sediment may be removed with a flush of liquid from the housing 1 or with the aid of an auger 17. It may be separated after emission from the apparatus by sedimentation or screening if desired.

The only moving part of the apparatus during the digestion period is the pump 8 which circulates the gas. It is the

intention, where possible, that the heat of compression can be extracted so as to render further heating unnecessary. However, in warmer climates, the use of solar heating for a heater 16 may speed up the start of the process and reduce the pressure required. Otherwise, provision to heat the gas, where required, may be by any suitable means.

CLAIMS

1. Apparatus for the treatment of bio-degradable waste material, comprising means defining a chamber for receiving such material and means for agitating the material in the chamber by supplying gas generated from bio-degradation of said waste material into a lower part of the chamber.

2. Apparatus according to claim 1, adapted for the thermophilic treatment of said material.

3. Apparatus according to claim 1 or 2, comprising means for withdrawing gas from the chamber generated by the bio-degradation of said material and pumping means for compressing such gas, the rise in temperature produced by the compression being used to heat material in the lower part of the chamber by passing the compressed gas through piping in the lower part of the chamber, the agitating means re-circulating such gas back to the lower part of the chamber.

4. Apparatus according to any preceding claim, wherein the agitating means comprises means for storing gas generated from the bio-degradation of said waste material and means for supplying gas from the storing means to the lower part of the chamber.

5. Apparatus according to claim 4 as dependent on claim 3, wherein said piping is connected to the storage means.

6. Apparatus according to any preceding claim, including means for heating gas supplied to the lower part of the chamber.

7. Apparatus according to claim 3 or any of claims 4 to 6 as dependent on claim 3, wherein there is further piping

below the first-mentioned piping and which receives gas to be supplied to the lower part of the chamber, such gas bubbling out of said further piping and through the waste material.

8. A method for the treatment of bio-degradable waste material, comprising receiving such material in a chamber and agitating the material in the chamber by supplying gas generated from bio-degradation of said waste material into a lower part of the chamber.

9. A method according to claim 8, wherein the treatment is thermophilic treatment.

10. A method according to claim 8 or 9, comprising withdrawing gas from the chamber generated by the bio-degradation of the material, pumping said gas to compress it, the rise in temperature produced by the compression being used to heat material in the lower part of the chamber by passing the compressed gas through piping in the lower part of the chamber, such gas being re-circulated back to the lower part of the chamber.

11. A method according to any of claims 8 to 10, wherein gas generated from the bio-degradation of said waste material is stored and supplied to the lower part of the chamber.

12. A method according to claim 11 as dependent on claim 10, wherein said piping is connected to the storage means.

13. A method according to any of claims 8 to 12, wherein gas supplied to the lower part of the chamber is heated.

14. A method according to claim 10 or any of claims 11 to 13 as dependent on claim 10, wherein there is further

piping below the first-mentioned piping and which receives gas to be supplied to the lower part of the chamber, such gas bubbling out of said further piping and through the waste material.

15. Apparatus or a method for the treatment of bio-degradable waste material, substantially as herein described with reference to the accompanying drawing.